

Purpose: To define basic properties of the duplex ultrasound diagnostic test for reflux in veins of lower extremities, and to examine if some of the elements of this test can be standardized in order to improve reproducibility.

Methods: This is a prospective multi-center study sponsored by the American Venous Forum Foundation. Vascular laboratories from 11 centers participated in protocol development, educational intervention, and data collection.

Repeatability studies were performed as a duplicate test within 2 weeks between replicates performed by the same technologist, at the same time of the day, using the same reflux provoking maneuver, and with patient at the same position. Repeatability was separately examined for different combinations of patient position, reflux-inducing maneuvers, and time of the test.

Reproducibility was examined by two different technologists, who performed the test at the same time of the day, using the same reflux provoking maneuver, and with the patient at the same position.

Facilitated reproducibility was studied by examining the same patients by two different technologists immediately after an educational intervention at the central laboratory.

In order to examine potential for decreasing in variability of results, limits of agreement between two duplex scans were studied by changing three elements of the test: time of the day (morning vs afternoon), patient's position (standing vs supine), and reflux initiation (manual vs automatic compression-decompression).

Results: A total of 51 patients were examined by different technologists during four sessions at the central laboratory. At the time of this abstract submission, an additional 68 patients were examined at participating laboratories.

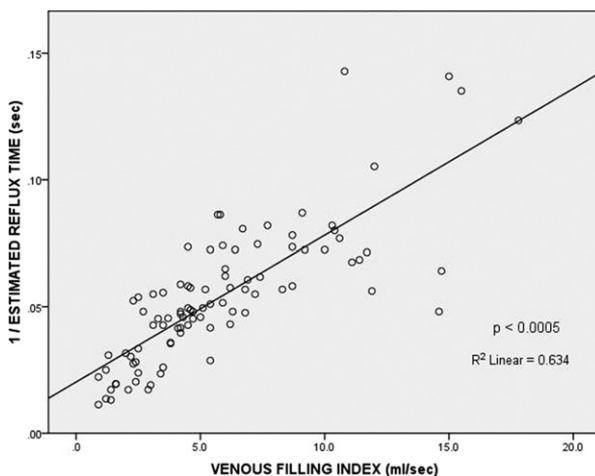
Overall repeatability was 97.7%, with higher values for superficial veins and lower for deep veins. Reproducibility was lower, which indicates a potential for improvement by standardization. This was confirmed by better reproducibility after educational intervention (facilitated reproducibility). The element of the test contributing to most significant variability was the time of the test.

Conclusions: Duplex ultrasound test for venous reflux is repeatable, but the reproducibility can be improved by standardization and training.

Reflux Time on Air Plethysmography is Shortened in Patients with Worsening Chronic Venous Insufficiency

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Background: The venous filling index (VFI), when elevated, is a measure of global venous reflux in the calf. Treatments that successfully abolish reflux normalize the value to under 2 mL/s. Duplex-derived reflux time (RT) at the sapheno-femoral junction (SFJ) has been shown to increase with disease severity, and its reduction has been used as an indicator of treatment success. Our hypothesis is that the stimulus to arrest reflux occurs



when the leg approaches venous capacity. The shorter the RT, the sooner the leg is subjected to the effects of maximal venous hypertension. Our aim was to investigate the direction of the relationship between RT estimated from air plethysmography (APG) and the VFI, a validated indicator of disease severity.

Methods: Ninety-three consecutive patients with primary SFJ reflux (>0.5 seconds) and great saphenous vein reflux (>0.5 seconds) awaiting endovenous treatment were included in the study. Patients with SFJ incompetence, deep venous reflux, or a history of a deep vein thrombosis were excluded. Baseline parameters (median, range) included age (mean, 48 years; range, 22-78 years), averaged great saphenous vein diameter at three sites (mean, 7.5 mm; range, 4-12 mm), and the clinical component of the CEAP classification (C3, C2-C6). A gravitational challenge was applied to an 'emptied' leg with the venous reservoir supported with a sensor cuff at an initial pressure of 6 mm Hg. RT was estimated using the software (ACI Medical, San Marcos, CA) as the time taken to reach 90% of the total venous volume, from the rapid filling phase seen on the monitor.

Results: Median and interquartile range of RT and VFI were 20 seconds (14) and 4.7 mL/s (4.3), respectively. Using APG, estimated reflux time is inversely related to VFI in patients with chronic venous insufficiency ($P < .0005$, Spearman's rho, linear $R^2 = .634$; Fig). Furthermore, shorter reflux time were observed in patients with worsening C scores ($P = .001$) and increasing great saphenous vein diameters ($P < .0005$).

Conclusions: Increasing great saphenous vein diameters may contribute to a faster rate of reservoir refilling (VFI). This results in a shorter RT with a worsening C score. The effects of maximal venous hypertension occur after the end of RT when the reservoir is full, so reflux time measured by air plethysmography may indicate more severe disease. Simultaneous duplex and air plethysmography studies are required to support these findings.

Incidence and Risk Factors for Development of Varicose Veins in the General Population: Edinburgh Vein Study

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Background: Numerous studies have reported on the frequency of varicose veins in the general population (prevalence) and associated lifestyle factors but very few have investigated, longitudinally, the development of new varicose veins (incidence). The aim of this study was to measure the incidence of varicose veins in the adult population and identify factors that increase the future risk of an individual to acquire varicose veins.

Methods: The study was a population cohort in which a random sample of 1566 men and women aged 18 to 64 years, examined at baseline in the Edinburgh Vein Study, were invited to have a 13-year follow-up examination. Assessment included clinical classification of venous disease using CEAP, duplex scanning to assess incompetence of venous valves, body mass index, and questionnaire on venous history and lifestyle factors.

Results: Eight hundred eighty study participants took part in the follow-up study and underwent clinical examination (response rate, 60%). Of the 555 participants who had no trunk varicose veins at baseline, 101 developed C2 trunk varicose veins in any leg during the 13-year follow-up. The annual incidence rate of trunk varicose veins was 1.35%. The incidence in men and women was similar with respective rates of 1.31% and 1.39% per year ($P = .45$). The risk of developing new varicose veins appeared to increase with age (incidence rate, 0.73% per annum in 18-34 years; 1.23% in 35-44 years; 1.62% in 45-54 years, and 1.93% in 55-64 years). Increased body mass index was also associated with incidence of varicose veins (incidence rate, 1.06% per annum in underweight; 1.28% normal weight; 1.41% overweight, and 1.54% obese). The incidence rate in those with no family history of varicose veins was 1.07% compared with 1.60% in those with a family history, but this finding was not statistically significant. Number of pregnancies was a significant risk factor, with an incidence rate of 1.24% per year in women who had never been pregnant, increasing to 2.11% per year in those who had been pregnant four times ($P = .02$).

Conclusion: The Edinburgh Vein Study is one of the first to measure the adult incidence of trunk varicose veins and to examine, longitudinally, factors which increase the risk of varicose veins. The associations found between risk factors and incident disease provides stronger evidence of causality than those in prevalence studies. Further analysis of other risk factors, including venous incompetence, and the impact of changing risk factors over time will be presented.

Progression of Chronic Venous Disorders: Results from the Bonn Vein Study

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Background: Chronic venous disorders (CVD) are among the most common diseases in Germany. In the Bonn Vein Study I (BVS I), conducted in 2000, 3072 participants of the general population of the city of Bonn and two rural townships, aged 18 to 79 years, took part in this study (1350 men, 1722 women). Participants were selected via simple random sampling from the registries of residents. In this follow-up study 6.6 years later, the same population was investigated again. The aim was to identify the incidence and